Categorical Obesity May Be Protective Against Certain Post-Operative Outcomes Following Total Knee Arthroplasty

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INTRODUCTION: With the growing prevalence of obesity in the adult population and increased risk for end-stage knee osteoarthritis in this population, the desire for total knee arthroplasty (TKA) in obese adults will likely continue to increase. However, the precise role of patient body mass index (BMI) in determining suitability for primary TKA remains contentious. At present, many healthcare institutions withhold access to TKA from patients above a threshold BMI, and may require preoperative weight loss; however, many patients ultimately fail to achieve requisite weight loss within a reasonable timeframe. More research characterizing the role of BMI in predicting complications following TKA is warranted to inform optimized management guidelines that are not overly restrictive while avoiding patient harm. The aim of this study was to evaluate the impact of BMI on outcomes, including operative failure, in a large population.

METHODS: In this retrospective study, adult male and female patients who underwent TKA at our institution between 2012 and 2021 were identified through search of a patient database. Inclusion criteria included primary TKA and adequate follow-up at one year. Patients were stratified by BMI according to World Health Organization category as normal weight (18.5-24.9 kg/m2), pre-Obesity (25.0-29.9 kg/m2), Obesity Class I (30.0-34.9 kg/m2), Obesity Class II (35.0-39.9 kg/m2), or Obesity Class III (≥40.0). Outcomes assessed for all patients included NQF 1550 outcomes; all-cause 30 and 90-day readmission; in-house, 30-day, and one-year mortality. Multivariate logistic regression using Stata 17 was used to compute Odds Ratio (OR) for all outcomes.

RESULTS:

24,973 patients (9,720 Males vs 15,253 Females) met criteria for inclusion. 700 patients had normal-range BMI, 4,105 patients had pre-obesity range BMI, 6,892 patients had obesity class I range BMI, 5,904 patients had obesity class II range BMI, and 7,372 patients had obesity class III range BMI. A Pearson chi^2 test demonstrated statistically significant differences in gender distribution across the five BMI groups ($p<0.001$) and distribution of white to non-white patients ($p<0.001$). Kruskal-Wallis tests between the five BMI groups demonstrated statistically significant differences in age ($p<0.0001$) and Elixhauser scores as well.

Compared to patients with normal BMI, pre-obesity, Obesity Class I, and Obesity Class II patients had lower odds of overall complications (OR = 0.43, 95% CI [0.23,0.82], p=0.01), (OR = 0.45, 95% CI [0.25,0.83], p=0.01), and (OR = 0.43, 95% CI [0.23,0.81], p=0.01), respectively. Obesity Class III patients; on the other hand, did not have statistical differences in odds of overall complications compared to normal BMI patients (p=0.07).

Compared against patients with normal BMI, obesity Class II patients had lower odds of postoperative pneumonia (OR = 0.09, 95% CI [0.01,0.65, p=0.02]) and Class III patients also had lower odds of postoperative pneumonia (OR = 0.06, 95% CI [0.01,0.47, p=0.01]). Pre-obesity and obesity Class I patients did not have statistical differences in odds of postoperative pneumonia when compared to normal patients (OR = 1 and p=0.08], respectively).

Compared against patients with normal BMI, pre-obesity patients had statistically lower odds of 7-day readmission (OR = 0.40, 95% CI [0.19,0.84, p=0.02]).

Compared against patients with normal BMI, pre obesity patients had lower odds of overall 30 day readmission (OR = 0.56, 95% CI [0.34,0.91, p=0.02]), obesity Class I patients had lower odds of 30 day readmission (OR = 0.61, 95% CI [0.38,0.98, p=0.04]), and obesity Class II patients had lower odds of 30 day readmission (OR = 0.61, 95% CI [0.38,0.98, p=0.04]).

Compared against patients with normal BMI, pre-obesity patients had lower odds of overall 90 day readmission (OR = 0.63, 95% CI [0.44,0.91, p=0.02]), obesity Class I patients had lower odds of 90 day readmission (OR = 0.64, 95% CI [0.45,0.91, p=0.01]), and obesity Class II patients had lower odds of 90 day readmission (OR = 0.66, 95% CI [0.44,0.92, p=0.02]). Obesity Class III patients did not have a statistical difference in odds of 90 day readmission when compared with normal patients (p=0.10]).

No significant differences were observed between normal BMI patients and patients who were in the pre-obesity or obesity Class I-III groups for length of hospital stay, myocardial infarction, death, mechanical complication, pulmonary embolism, sepsis, wound infection, in house mortality, all-cause mortality at 30, one year mortality, or CJR readmission at 30 and 90 days

DISCUSSION AND CONCLUSION:

While prevalent clinical thought and previous studies suggest increasing BMI is a poor prognostic indicator for patients undergoing TKA, in our population, pre-obesity and obese status did not confer greater odds of any given adverse outcome. Instead it demonstrating protective effects against a variety of outcomes. Pre obesity may be related to decreased overall complications and readmission rates at 7, 30, and 90 days. Similarly, obesity Class I demonstrated

lower odds for overall complications and readmission rates at 30 and 90 days. Obesity Class II may be protective against overall complications, postoperative pneumonia, and readmission at 30 and 90 days. Lastly, obesity Class III only showed protective effects against postoperative pneumonia.

This protective effect of obesity, along with a larger proportion of all TKA's coming from overweight BMI groups, describe an "obesity paradox". This is similar to what has previously been identified in oncologic studies, where obesity may be a risk factor for cancer but associated with improved treatment outcomes.

Further study is needed, including evaluation of patient BMI as a continuous rather than categorical variable, to better characterize outcome patterns within BMI classifications and to determine how medical comorbidities may individually modulate this relationship. This, in turn, may inform evidence-based recommendations governing the threshold BMI at which the probability of adverse outcomes outweigh patient benefit.